Ocean Surface Salinity Remote Sensing With A Passive/Active L-/S-Band Microwave Instrument

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Microwave radiometry and scatterometry are well established techniques for surface remote sensing. Combining passive and active sensors provides complementary information contained in the surface emissivity and backscatter signatures, which may improve the accuracy in the retrieval of geophysical parameters. For example, over the ocean, the passive radiometer brightness temperature is a function of the Sea Surface Salinity (SSS), the Sea Surface Temperature (SST), and the surface roughness from wind and waves.

To investigate the benefits of combining passive and active microwave sensors, the Jet Propulsion Laboratory has designed, built and tested a new precision Passive/Active L/S-band (PALS) microwave aircraft instrument for measurements of ocean salinity. Because the L-band brightness temperature variations associated with salinity changes are small, e.g. a salinity change of 0.2 PSU results in a brightness temperature change of 0.1 to 0.2 K, it was necessary to build a very accurate, sensitive and stable system. This instrument has a high beam efficiency conical horn with relatively low sidelobes, a dual-frequency (L- and S-band), dual polarization radiometer and polarimetric radar sensors. Salinity measurement missions were flown using the NCAR C-130 aircraft on July 17-19, 1999, Virginia over the Gulf Stream and in August, 2000 following the M/V Oleander ship track between Newark, New Jersey and Bermuda. The measurements indicated a clear and repeatable salinity signal across the Gulf Stream, which was in good agreement with the Cape Hatteras ship salinity data. There were observations from several areas with a strong wind gradient. It was estimated that the excess brightness temperature due to 1 m/s change of wind speed is about 0.2 K for vertical polarization and 0.4 K for horizontal polarization. It is shown that by adding an scatterometer, more direct information on the surface roughness is provided, which significantly improves the accuracy of the retrieved SSS. The surface salinity retrieved from the PALS data is in agreement with the in-situ observations measured by the M/V Oleander vessel.

Implications of the PALS measurements for spaceborne systems are discussed for several specific instrument configurations under the considerations of various geophysical error sources and sampling pattern. It is suggested that an accuracy of 0.1 psu is reachable for global monthly satellite products on 1-degree latitude by 1-degree longitude grid.